Corps of Engineers Research aids Environmental Stewardship, Restoration and Protection

Environmental stewardship, restoration and protection are integral to the U.S. Army Corps of Engineers mission. In support of this mission, we conduct state-of-the-science, cost-effective research and development that has demonstrated national and international as well as project-specific value. This R&D ranges from recovery plans for threatened and endangered species to control of nuisance aquatic species, to disposal alternatives for contaminated sediments, to aquatic ecosystem processes and water quality modeling to cultural resources preservation. Examples of Corps environmental R&D efforts include:

1. Aquatic Ecosystem Restoration Guidelines

Guidelines developed by the Corps' Engineer Research and Development Command (ERDC) to support aquatic ecosystem restoration are being used by other agencies in addition to the Corps, including:

- the Natural Resources Conservation Service (NRCS), as a basis for standards for stream restorations;
- the United States Forest Service (USFS) in watershed management practices; and
- the National Marine Fisheries Service (NMFS) in salmon recovery efforts.

In addition, through training workshops in 14 states, the guidelines have reached numerous state and local organizations.
http://www.wes.army.mil/el/emrrp/emrrp.html

2. Watershed Analysis of Wetlands

Over the last three decades, the Corps has been an international leader on all facets of wetlands R&D, including wetlands ecological functions, values and restoration methodologies http://www.wes.army.mil/wetlands/wetlands.html. The Corps approach to wetlands classification, the Hydrogeomorphic (HGM) approach, is the standard for the federal water resources management community. The Corps is presently modifying this methodology for use in assessing the integrity of wetland ecosystems in the Santa Margarita and San Jacinto watersheds in southern California. Ultimately, this technology will be able to generate maps to illustrate the degree of improvement in wetland ecosystems that can be expected from restoration in particular stream segments and wetland areas.

3. Contaminated Sediment Removal Options

Contaminated sediments in many industrial and urbanized harbors and waterways contribute to environmental degradation. Disposal alternatives for these contaminated sediments are to confine, contain, treat, or simply not remove them and hope they remain undisturbed. The most common alternatives are placement in Confined Disposal Facilities (CDFs) or capping in underwater sites. Over the years, Corps scientists and engineers have conducted extensive R&D to develop contaminant controls, treatment methods, and management techniques for both CDFs and capping alternatives. Corps research is also examining filtration treatment and enhanced biodegradation of contaminants. http://www.wes.army.mil/el/dots/doer/doer.html. The Corps uses this expertise in supporting the Environmental Protection Agency (EPA) on a number of complex Superfund projects involving removal of contaminated sediments. For example, ERDC is acting as the technical leader for the Corps' Los Angeles District and EPA in a study of capping options for California's Palos Verdes Shelf.

4. Management of Water Quality

Removal of water quality impairments in virtually every river, stream, lake, and estuary in America is a primary objective of the President's clean water initiatives. Developing these plans is a tremendous undertaking that requires comprehensive sampling, analysis, and forecasting. Based on its extensive expertise in watershed and aquatic ecosystem-level water quality modeling, ERDC is presently developing a model system that can be used to determine Total Maximum Daily Loads (TMDLs) of pollutants for the St. Johns River in Florida. The result will be a state-of-the-art tool to develop effective, economically viable TMDLs for the St. Johns River that should prove useful for similar applications elsewhere within the U.S. http://www.wes.army.mil/el/elmodels/index#wqmodels

5. Groundwater Modeling System

Corps engineers and scientists developed the Groundwater Modeling System (GMS) as a tool to understand the flow and movement of contaminants in groundwater for use in developing strategies to remove them. The GMS evaluates contaminant data, develops a subsurface conceptual model, and simulates subsurface flow, contaminant transport, and evaluates the effectiveness of alternative removal systems. The GMS simplifies the process of groundwater flow and transport modeling by bringing together all of the tools needed to complete a successful study. http://chl.wes.army.mil/software/gms/.
The GMS has been used to study groundwater at a number of Army and Department of Energy site, including a pump-and-treat system at Pueblo Chemical Depot, Colorado. The Engineer Research & Development Command has been modeling this site since the design of the system and is providing visualizations and information to address regulators' questions

and concerns. By using the living model concept, new information can continually be incorporated in to the conceptual and numerical models.

6. Salmon Recovery Research

The Engineer Research & Development Command (ERDC) supports Corps districts looking for better understanding of the impacts of lock and dam operations on salmon recovery efforts. Scale physical models of the gate slots at Bonneville Lock and Dam, on the Columbia River in Oregon and Washington, are being used to examine flow conditions. Various modifications on vertical barrier screens within the gate slots are being investigated to redirect the flows so that the juvenile salmon are not injured.

Knowledge of how out migrating juvenile salmon respond to the hydrodynamic effects of turbine intakes, gates, fish collectors, and other hydraulic structures is a critical component of the knowledge base needed for salmon restoration. ERDC researchers have discovered the hydrodynamic cues used by juvenile salmon at Lower Granite Dam on the Snake River with the aid of an advanced Computational Fluid Dynamics (CFD) model. This information can be used to design more efficient bypass systems. Examples of the analysis can be found at: http://www.wes.army.mil/el/emrrp/nfs/animations/animations.html.

7. Nuisance Aquatic Species Control Research

It is estimated that over 100 nuisance species are introduced into U.S. waters each year, severely impacting water resources project operations and threatening valued natural resources. The zebra mussel alone costs the public over $1 billion annually due to blocked water intake pipes and lock gates.

The Engineer Research & Development Command (ERDC) is the lead federal laboratory for developing control strategies for a range of nuisance aquatic species. Biological and chemical control technologies developed by ERDC have reduced infestations of water hyacinth in the Gulf Coast states and California by over 50 percent, and have reduced control costs for hydrilla by Corps districts by over $3 million annually.

Ongoing R&D in this area includes development of dispersal barriers for zebra mussels and other nuisance aquatic animals, ecologically-based control strategies to reduce chemicals entering the aquatic environment, and strategies to replace nuisance populations with native plant and animal species . http://www.wes.army.mil/el/aqua/aqua.html

8. IWR-PLAN Software

Most "traditional" Corps projects are justified in terms of the monetary benefits they offer - cheaper transportation, flood damages prevented, etc.

For environmental work, however, it is difficult, often impossible, to assign a dollar value.
The IWR-PLAN software package, developed at the Corps' Institute for Water Resources at Fort Belvoir, VA, supports decision-making for ecosystem restoration and mitigation planning in which the benefits of different alternatives are counted in acres of habitat or any other measurement other than dollars. This software calculates the additive effect of those alternative plans on up to 10 user-defined variables, such as cost and non-dollar output. IWR-PLAN's evaluation routine then performs cost effectiveness and incremental cost analyses (CE/ICA) on those alternatives, as required by Corps guidance in lieu of benefit-cost analyses. CE/ICA helps to identify the most efficient alternative for any given level of environmental output, and also to compare the incremental environmental outputs - how much additional benefit for every additional dollar spent. IWR-PLAN software identifies the alternatives that are the best financial investments (the "cost effective" and "best buy" plans) and displays the effects of each alternative on a range of decision variables. The Corps is now exploring other decision-making uses for IWR-PLAN beyond ecosystem restoration analyses, such as prioritization of operations activities or ranking of hazardous waste clean-up sites. The software and user instructions are available at http://www.iwr.usace.army.mil.

9. Restoration planning with the Ecosystem Functions Model

The Corps of Engineers Hydrologic Engineering Center at Davis, CA, is developing the Ecosystem Functions Model (EFM), a tool that analyzes ecosystem response to changes in water flow. It is applicable to a wide range of ecosystems and Corps projects. Environmental planners, biologists, study managers, and engineers will use the information generated by these models to help determine whether proposed study alternatives (e.g., reservoir operations, channel modifications, or levee alignments) would maintain, enhance, or diminish ecosystem health. A graphical user interface allows easy entry of model input and visualization and analysis of output. Three pilot applications of the EFM have been made in the Sacramento and San Joaquin River Basins in California, and the Corops is exploring opportunities to use the EFM in other States. A beta version of the software is expected by the end of April 2002. (http://www.hec.usace.army.mil)

10. Improving Environmental Benefits Analysis

Improving environmental benefits analysis is key to making sound investment choices for environmental projects. The Institute of Water Resources is examining analytical approaches and methods for characterizing, measuring and comparing the outputs from ecosystem restoration measures. The study effort has two broad focus areas: 1) identification and assessment of available

procedures for measuring environmental outputs in non-monetary terms, and 2) project evaluation frameworks for proposals that serve multiple purposes, expressed in monetary and non-monetary terms. The results of this study will be useful in improving Corps ability to analyze problems and alternatives, particularly for multipurpose studies, to discuss the value of recommended projects with sponsors and stakeholders, and ultimately to improve performance assessment for ecosystem restoration investments. (http://www.iwr.usace.army.mil)